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MISCELLANEOUS ELECTRICAL ENERGY USE IN HOMES

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Abstract - About 18% of all U.S. residential electricity, or 1600 kWh/yr per household, is used for miscellaneous appliances. Such appliances include waterbeds, dehumidifiers, television sets, well pumps, and clocks. The saturations, stocks, and electricity use for 35 appliances within the miscellaneous category have been estimated. Nationally, few miscellaneous appliances consume more than 2% of total electricity use, compared to 20% for refrigerators and 12% for electric water heating. However, in any given home, one of several miscellaneous appliances could be among the largest consumers of electricity. Failure to recognize the contribution of miscellaneous appliances to overall electricity demand can lead to erroneous forecasts because their demand is incorrectly attributed to space heating, air conditioning, refrigeration, and other standard end uses. In addition, there will be smaller savings from conservation programs aimed at standard end uses. Several trends suggest that the energy use of miscellaneous appliances will grow. In some new homes, miscellaneous appliances account for more than 40% of total electricity use.

INTRODUCTION

The miscellaneous use of electricity in homes has not been well measured or even defined. Most analysts treat it as a residual, i.e. as electricity that has not already been accounted for in other end uses. Thus, miscellaneous end use consists of appliances that were not considered sufficiently important to list explicitly and estimate.

In this paper, unit electricity consumptions (UECs) are estimated for 35 appliances within the miscellaneous category of the residential sector in the US. Saturations for these appliances are also estimated. Next, the total national electricity consumption for those same appliances is calculated. This compilation represents a major extension of earlier estimates by Meier[1] and Rainer et al.[2]

DEFINITION OF MISCELLANEOUS END USE

Miscellaneous (other or residual) end use is typically defined as electricity not consumed by familiar end uses. Familiar end uses generally include space heating, water heating, refrigeration, cooking, clothes drying, and air conditioning. Other end uses, such as lighting, pool heating, television, and furnace fans, are sometimes included but there is no consistent definition. Table 1 lists estimates of miscellaneous electricity use in several studies and their definitions of standard end uses. Miscellaneous end use thus includes all end uses not explicitly covered. In three national studies supported by the Department of Energy,[3] EPRI,[4] and the Lawrence Berkeley Laboratory,[5] miscellaneous use consumed from 7 to 26%. The authors of a study at Pacific Northwest[6] estimated that 30% of residential electricity use was miscellaneous. In California, estimates of the miscellaneous component have ranged from 2% in 1979[7] to 26% in 1988[8] and 41% in 1990[9] for a group of newly-constructed, energy-efficient homes. Finally, a 1984 study for one utility in Oklahoma[10] did not even include a miscellaneous component.

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Table 1. Other estimates of miscellaneous residential electricity use.

Study Location	Size of Misc. End Use (% of electricity)	End Uses Explicitly Covered Elsewhere
1987 U.S. Residential Energy Conservation Survey [3]	21%	A, B, C, T
Typical U.S. residences [4]	26%	A, C
LBL Residential Energy Model [5]	7%	A,B,C,D,L
Northwest U.S. homes [6]	30%	A, C, dryers
1988 California homes [7]	26%	A, L, "small appliances"
1979 California homes [8]	2%	A, B, C, L, waterbeds, TVs, pool filters/pumps
1990 New California homes [9]	41%	A, B, C, waterbeds, pool
Choctawhatchee Utility (Oklahoma) [10]	0%	A, B, C

Key: A = space heating, water heating, refrigerators and freezers, air conditioning; B = clotheswashers, dryers; C = range; D = dishwasher; L = lighting; T = televisions.

The extraordinary diversity in the miscellaneous category makes it easier to define it by what it is not. Thus, the miscellaneous category consists of any activity not included in standard end uses, that is, not space heating, water heating, refrigeration, air conditioning, cooking, lighting, clothes drying, or clothes washing. Examples of miscellaneous appliances are waterbed heaters, television sets, auto engine block heaters, toaster ovens, garbage disposals, hair dryers, aquariums, and stereos.

Many standard end uses now include supplementary appliances that are nevertheless treated as miscellaneous. For example, the stove is the principal appliance in cooking end use, but the microwave oven, toaster oven, and coffee maker all provide some cooking services. Similarly, ceiling fans supplement the air conditioner. We chose to assign appliances such as microwave ovens and fans to the miscellaneous category. We also included the electricity consumed by fan motors in gas furnaces (since they are often ignored) and the crankcase heaters on heat pumps (because they operate during the non-heating season).

ENERGY USE IN MISCELLANEOUS APPLIANCES

Stock and electricity-consumption data for many of the appliances typically included under miscellaneous end use are listed in Table 2. We have estimated ranges of energy use based on measurements or engineering calculations. In Table 2, we give ranges for the saturation of each appliance. These numbers are the number of households with one or more of the appliance present and are based on census, utility, and trade-industry data in addition to our own estimates. The range of energy use covers about 80% of the units, i.e. 10% of the stock uses less energy than the minimum and 10% of the stock uses more than the maximum. More appliances will be added and the estimates improved as further information becomes available.

Each of the miscellaneous appliances has a unique pattern of energy use. A few of these features are illustrated in the examples discussed below. The appliances have been chosen to illustrate the range of information known about an appliance, its electricity use and load profile.

With recognition and improved information about miscellaneous appliances, it is possible to develop more reliable conservation measures. The following examples do not specifically address conservation measures that might be applied to the appliances but demonstrate how failure to recognize miscellaneous appliance use will lead to incorrect or inappropriate conservation measures in standard appliances.

Table 2. Ranges in saturation and energy use for appliances in the miscellaneous category.

End Use	National Saturation, Min.-Max.	UEC (kWh/year) Min.-Max.
Aquarium / Terrarium	0.05 - 0.15	200 - 1000
Audio Systems	0.70 - 0.90	10 - 100
Black & White TV	0.50 - 0.60	10 - 100
Blanket	0.25 - 0.35	70 - 200
Bottled Water Disp.	0.01 - 0.02	200 - 400
Ceiling Fan	0.20 - 0.40	10 - 150
Clock	1.00	17 - 50
Coffee Maker	0.30 - 0.50	20 - 300
Color TV	0.96 - 0.99	75 - 1000
Computer	0.10 - 0.20	25 - 400
Crankcase Heater	0.25 - 0.35	100 - 400
Dehumidifier	0.10 - 0.13	200 - 1000
Dishwasher	0.38 - 0.45	75 - 500
Exhaust Fan	0.30 - 0.60	2 - 70
Engine Heater	0.02 - 0.06	150 - 800
Furnace Fan	0.45 - 0.60	300 - 1500
Garbage Disposer	0.40 - 0.50	20 - 50
Grow-Lights and Acc.	0.02 - 0.05	200 - 1500
Hair Dryers	0.70 - 1.00	10 - 80
Humidifier	0.08 - 0.15	20 - 1500
Instant Hot Water	0.005 - 0.02	100 - 300
Iron	0.20 - 0.40	20 - 150
Microwave Oven	0.70 - 0.90	50 - 300
Mower	0.05 - 0.08	5 - 50
Heat Tape	0.02 - 0.05	30 - 500
Pool Pump	0.04 - 0.06	500 - 4000
Spa/Hot Tub	0.01 - 0.02	1500 - 4000
Sump/Sewage Pump	0.10 - 0.20	20 - 200
Toaster / Toaster Oven	0.90 - 1.00	25 - 120
Vacuum Cleaners	0.90 - 1.20	5 - 50
VCR	0.60 - 0.70	10 - 70
Waterbed Heater	0.12 - 0.20	500 - 2000
Well Pump	0.05 - 0.20	200 - 800
Whole House Fan	0.08 - 0.10	20 - 500
Window Fan	0.05 - 0.15	5 - 100

Well Pumps

About 10 - 15% of all American homes have well pumps, although in some rural areas the saturations are much higher. Maine, for example, has a saturation of over 32% and about 20% of new homes in the Pacific Northwest have well pumps. The actual energy used by a residential well pump depends on the amount of water pumped, the height lifted (or head), and the efficiency of the pump. A typical well pump has a rated capacity of 0.5 - 2 kW, and operates at most a few hours per day. A pressurized storage tank maintains water pressure and matches demand and supply.

Measured energy use data for pumps are scarce. The five studies we found took place in Michigan,[11] Maine,[12] Connecticut,[13] Pacific Northwest,[14] and Nevada (see Table 3).

Table 3. Well pump monitoring studies.

Location	No. of Pumps Monitored	Average Energy Use (kWh/year)	Source
Maine	12	235	Central Maine Power, 1988
Michigan	31	495	Personal Communication, Terri Bortmann, April, 1990.
Connecticut	1	237	Personal Communication, Russell Johnson, July 30, 1990
Pacific Northwest	41	441	Personal Communication, Megan Taylor, August 15, 1990.
Nevada	2	270	LBL

The Pacific Northwest study demonstrates some of the problems with well pump energy data. Among the 41 pumps monitored, the usage varied from 16 kWh/year to 4155 kWh/year, making the median usage (441 kWh/year) more realistic than the mean (945 kWh/year). Auditors gave various names to the pumps, including Pump, Water Pump, and Well Pump. Some of the larger users are undoubtedly agricultural users but even here some of the water is still used for residential purposes. A stricter definition of well pumps is needed if monitored data such as these are to be useful.

The Maine data may be a little low because a few of the homes were not continuously occupied. Even in relatively wet Michigan, summer use is significantly greater than in the winter. In arid climates, the water table is deeper and more irrigation is needed. For these reasons, the low values for Nevada are surprising.

Electricity used for pumping could be easily confused with that for air conditioning on monthly utility bills. In Maine, the peak summer energy use for well pumps was twice that of the lowest winter month. Figure 1 shows the monthly profile for the 31 Michigan residential well pumps. Arid regions, where water is also needed for maintaining a garden, would show a greater absolute difference between summer and winter energy use. Indeed, maintaining a large lawn in some Western locations will require a significant energy investment.

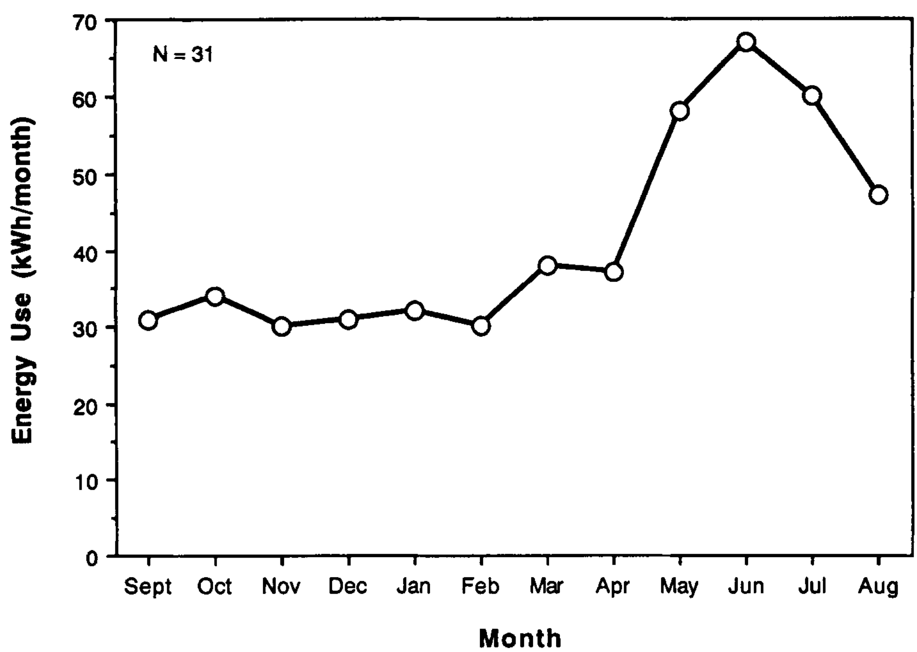

Fig. 1. The monthly electricity consumption profile for 31 residential well pumps in Michigan. Source: Consumers Power Co.

Based on the scanty data available, we believe that the average electricity use by well pumps is about 400 kWh/year. However, pumps west of the Mississippi River (that is, in more arid regions and with higher heads) could use over 700 kWh, while those in the East consume less. In some areas, the measures taken to protect against freezing (heating the pump house, for example) may use more electricity than the pump itself.

Waterbeds

Between 15 and 20% of all homes have waterbeds, and most of them are heated with an electric resistance coil underneath.[15] Over 32% of Colorado homes have waterbeds.

The waterbed is often the largest electricity-using appliance in a home. Several studies have measured their energy use. Studies in California[16] and Maine[17] found the annual usage to be about 500 kWh/year per heater. Another study in Michigan[18] found usage as high as 3,000 kWh/year. Several California tests, including one in a utility research laboratory,[19] a typical home[20] and state testing laboratory[21] showed average consumption ranging from 950 to 1480 kWh/year. The consumption of 500 kWh is low because it was obtained in a warm climate; the other was predominantly based on measurements of single-size (twin) beds. On the other hand, the older tests may have shown higher consumption owing to king-size water bags and a lack of frame insulation.

Electricity usage of waterbeds is highly seasonal, with up to a factor of five difference between coldest and warmest months. The usage depends on size, bed temperature, ambient temperature, bed coverings, and insulation around the water bag.

A waterbed's load shape is unfavorable to most utilities. The peak demand coincides with other appliances, such as cooking, lighting, and water heating. Figure 2 shows that the peak usage occurs during the morning, beginning at 7 a.m., and does not fall significantly until after noon. This shape suggests that waterbed owners leave the covers off the bed once they get up, and do not make their beds until later in the day--an expensive practice.

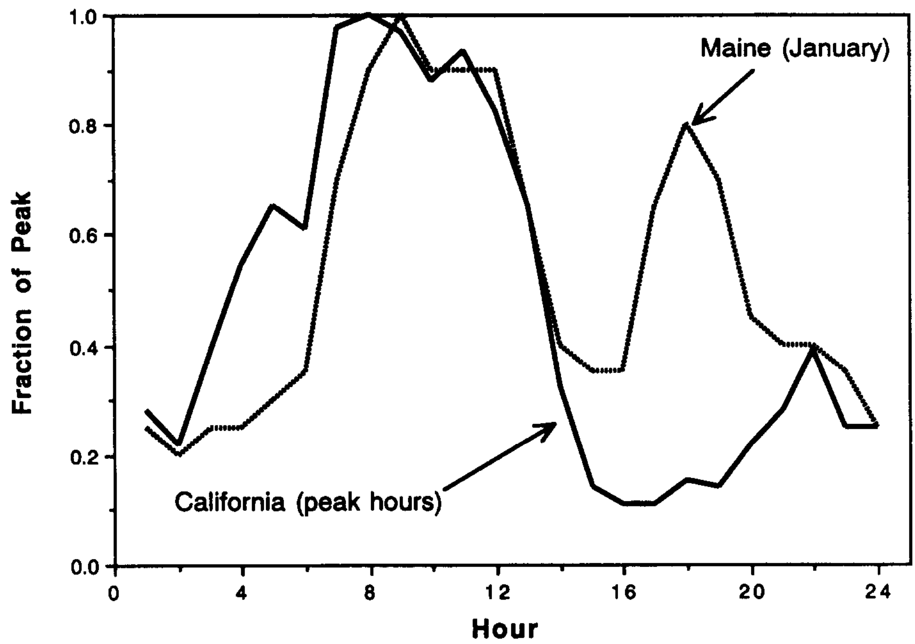

Fig. 2. Load shapes for electricity consumed by waterbed heaters. Sources: Central Maine Power and Southern California Edison Co.

Electric Blankets

About 76% of homes have one or more electric blankets.[22] However, probably only half of those owned are regularly used.[23] Annual energy usage per blanket depends on frequency of use, size, setting and presence of an additional covering. A Pacific Gas and Electric Co. study[24] estimates between 0.6 and 1.2 kWh/night, in bed sizes ranging from twin to king. Another[25] lists annual energy use at 147 kWh per blanket, which, if we assume an average of 0.8 kWh/night for half the year, agrees well with the PG&E data. Thus about 4 TWh/year are used by electric blankets. The load shape of electric blankets is nearly ideal from the standpoint of a summer-peaking utility because the electric blanket's use coincides with times when few other appliances are being used.

Many more non-domestic appliances will appear in homes in their new service as offices, factories, and hospitals. As these appliances approach 1 - 5% saturation, their national energy use will become significant. But when a home is used for non-domestic enterprises, the hours of occupancy will also rise. This will lead to increased energy use for space conditioning, water heating, and lighting. However, the gradually increasing efficiency of the standard appliances, suggests that the miscellaneous will become relatively more important over time. This trend is supported by the recent California study.

Bizarre But True

In our research, we have encountered many unusual uses of energy. These appliances include a piano warmer, a lint remover, an aquarium cooler, and electric fences. Some appliances, once thought to be silly or science fiction, are now appearing in the marketplace. Electrically-heated toilet seats are popular in Japan, and will soon be marketed in the United States. These thermostatically-controlled devices draw 75W in a cool bathroom. Electric bread-baking appliances substitute for the conventional stove and have recently become popular. Extensive basement horticultural enterprises to raise marijuana and other forbidden plants are more common that one might expect (and occasionally trigger utility inspections after the accounts were flagged as "unusual" by bill-screening programs).

NATIONWIDE MISCELLANEOUS ENERGY USE

An estimate of nationwide residential miscellaneous electricity use is presented, in order of decreasing consumption, in Table 4. Our best estimates of average energy use (based on the ranges shown in Table 2) and stocks were used to calculate nationwide energy consumption.

Table 4. The estimated average electricity use and saturations of appliances in the miscellaneous category.

End Use	Stock (millions)	UEC (kWh/year)	National Consumption (TWh/year)	Percent of Total Household
Furnace Fan	45	500	22.5	2.78
Color TV	87	250	21.8	2.69
Waterbed Heater	14	900	12.6	1.56
Microwave Oven	72	120	8.6	1.07
Dishwasher	36	200	7.2	0.89
Pool Pump	4	1500	6.0	0.74
Aquarium / Terrarium	10	548	5.5	0.68
Crankcase Heater	27	200	5.4	0.67
Spa / Hot Tub	2	2300	4.6	0.57
Clock	180	25	4.5	0.56
Well Pump	11	400	4.4	0.54
Dehumidifier	11	400	4.4	0.54
Toaster / Toaster Oven	86	50	4.3	0.53
Audio System	81	50	4.1	0.50
Hair Dryer	85	40	3.4	0.42
Blanket	27	120	3.2	0.40
Vacuum Cleaner	90	30	2.7	0.33
Ceiling Fan	54	50	2.7	0.33
Grow-Lights and Acc.	3	800	2.4	0.30
VCR	59	40	2.4	0.29
Coffee Maker	36	50	1.8	0.22
Black & White TV	45	40	1.8	0.22
Computer	13	130	1.7	0.21
Iron	32	50	1.6	0.20
Humidifier	11	100	1.1	0.14
Engine Heater	4	250	1.0	0.12
Exhaust Fan	54	15	0.8	0.10
Whole House Fan	8	80	0.6	0.08
Sump/Sewage Pump	13	40	0.5	0.06
Garbage Disposer	40	10	0.4	0.05
Heat Tape	3	100	0.3	0.04
Bottled Water Disp.	1	300	0.3	0.04
Window Fan	9	20	0.2	0.02
Mower	5	10	0.1	0.01
Instant Hot Water	0.5	160	0.1	0.01
Total Miscellaneous	--	1610	145	18
Total Household	90	8978	808	100

Ceiling Fans

Ceiling fans have experienced strong sales in the 1980s. Most utility appliance surveys in the early 1980s did not even bother to ask customers if they had ceiling fans. By 1985, however, over 50% of Alabama houses had ceiling fans; by 1989, over 81% of new homes had fans. Even homes in northern regions have ceiling fans; saturations exceed 30% in New Jersey. As a result, about 30% of the homes in the U.S. now have them, although the saturation varies greatly with region. We found no measurements of their energy use, but we estimate the energy use (per fan) to vary from 10 - 150 kWh/year. For those homes with ceiling fans, we estimate that the average energy use is 50 kWh/year.

Many houses have both air conditioners and fans. The fans both substitute for and supplement air conditioning. During warm periods, the fans provide thermal comfort. During the hottest periods, however, the air conditioner is the principal cooling source (but may be supplemented by the fan). Ceiling fans also extend the cooling season by providing comfort at transition temperatures when occupants would not have otherwise switched on the air conditioner.

In a utility bill analysis, an energy auditor could easily confuse the electricity used by ceiling fans and air conditioners. By ignoring ceiling-fan energy use, the auditor would overestimate the energy used by the air conditioner. The auditor might then recommend conservation measures that are not cost-effective because the true savings would be less than estimated. For example, if the auditor failed to recognize that half of the cooling electricity was used by ceiling fans, then the true savings from a new, high-efficiency air conditioner would be half the auditor's prediction.

Aquariums

Aquariums are popular for both the fish and underwater flora in them. There are about ten million aquariums in the United States. The tropical fish and plants require carefully controlled temperature and lighting conditions. The typical aquarium is equipped with a light, heater, and a small pump. Some of the more exotic set-ups can have as much as 300 watts of lighting operating 10 to 12 hours per day.

A recent study[26] showed that the electricity use of a 55 gallon aquarium could vary from 1 - 7 kWh/day, depending on temperature. For an average-sized unit, we estimate a use of 1.5 kWh/day. A few units must also be cooled during the summer, either evaporatively with a fan, or directly with ice or cooling coils.

Computers and Office Equipment

There are about 20 million computers in American homes. This estimate includes both personal computers (PCs) and video games. However, it is not clear how many of these units are regularly used.

Nameplate ratings for computers and related office electronics are often misleading. The measured power use is typically 20-40% of the nameplate. Harris et al[27] measured the average and peak power consumption of over thirty configurations of desktop and portable computers, in addition to printers and copiers. The average measured power ranges from 50 Watts or less for portables, game computers, and small PCs to 200 Watts for large PCs with hard disks, extra cards, and color monitors. A computer used as part of a business in the home is likely to be on at least eight hours per day. Once turned on, it is rarely turned off because of the inconvenient delay in re-starting it. We estimate that the range of electricity consumption for computers and office equipment is 25 - 400 kWh/year, and the average is about 130 kWh/year.

The Home as an Office, Factory, or Hospital

The National Association for the Cottage Industry estimates that 20 to 30 million households are also used for all or part of the occupant's livelihood.[28] This office-at-home phenomenon is becoming so institutionalized that a builder in Florida plans to install two kilowatt-hour meters in new houses (to allow for separate billing). Many of these home-offices rely on PCs, printers, photocopy machines, and faxes.

Home-factories produce a wider range of items than home-offices. Home-factory enterprises include catering, sewing, wood and metalwork, and marijuana cultivation. Each enterprise has its own special tools and equipment. Catering requires additional food processing and refrigeration equipment. Carpentry and metalwork relies on lathes, drills, and other tools. Pottery and ceramics requires kilns. Sewing requires sewing machines and equipment to clean, dye, and prepare fabrics. Cultivation of plants -- particularly marijuana -- requires extensive lighting, ventilation, and even heating. Data on the extent of these activities are practically non-existent because they are often operated informally without full licensing or business permits (or are simply illegal).

The home-as-a-hospital is a second (though smaller) trend that will create new miscellaneous uses of electricity. The high cost of hospitalization has encouraged more frequent and elaborate out-patient care. Many utilities maintain lists of customers with life-support systems in case of black-outs, and a few states have established special rates for customers with special medical equipment. The range of equipment involved is enormous, from simple air cleaners to sophisticated life-support systems. It is impossible to assign a typical electricity use to this activity. Yet many of these appliances operate continuously or generate heat -- both reliable indicators of high electricity use. The next compilation will include estimates of energy use for the most common equipment.

The total miscellaneous electricity consumption is about 145 TWh/year or 18% of 1989 residential electricity consumption. This estimate of 18% is higher than most end use breakdowns (see Table 1) although strict comparisons are difficult because of differences in definitions. Our estimate includes some electricity that is typically included in the standard end uses (such as microwave ovens) but excludes many significant end uses frequently included in the miscellaneous category (such as lighting, clothes dryers, etc.). When these differences are taken into account, most studies probably underestimate the miscellaneous (according to their definitions) electricity use. The error may be as large as 15% of total residential electricity consumption.

From a national perspective, the individual appliances in the miscellaneous end use category consume small amounts of electricity. But the low national consumption may be due either to low per-unit energy use or low saturations. For example, the two hundred-million electric clocks in the U.S. (about two per home) consume 4.5 TWh/year or 0.6% of total residential electric use. In contrast, dehumidifiers are present in only 10% of the homes but these consume about the same amount of total electricity.

An energy auditor will mostly likely focus on the refrigerator, water heater, and space heating system because these are the major electrical end uses. Refrigerators and water heaters consume about 20% and 12%, respectively, of residential electricity. A competent auditor will ignore the energy use of clocks because they consume only 17 - 50 kWh/year. But he or she would make a serious omission by ignoring a dehumidifier since it often consumes over 400 kWh/year. Moreover, a dehumidifier's electricity consumption pattern is similar to an air conditioner; in houses having both appliances, a dehumidifier's electricity use could be mistakenly attributed to air conditioning in the electricity bill analysis. Worse, the excessive energy use of a *defective* dehumidifier might be attributed to excessive air conditioning.

DISCUSSION

On a nationwide basis, no single appliance within the miscellaneous end use category consumes as much electricity as the standard major appliances. Auditors, however, should not rely on national averages to guide their audits. In specific homes, miscellaneous uses represent the largest end use category and can easily exceed the electricity used for a water heater or refrigerator. Some of these appliances, such as waterbed heaters, aquariums, and pool equipment, are already present in up to 15% of American homes. In addition, the home-as-an-office trend will ensure that more non-residential appliances will appear in the home. The energy audit must become increasingly sophisticated because failure to identify miscellaneous uses will cause unrealistically high estimates of energy use for the standard end uses. This omission will also lead to overestimates of energy use by the standard appliances and overestimates of potential savings from conservation measures applied to them.

The linkage between an end use and a specific appliance is weakening. This is most evident in the cooking end use. Once cooking was almost exclusively performed with the stove. Now, the cooking end use is shared among the stove, microwave, toaster oven, coffee maker, and a host of other specialized appliances. The "cooling" end use is undergoing a similar de-coupling. The primary appliance remains the air conditioner, but the de-humidifier and ventilation equipment (particularly ceiling fans) are responsible for an important fraction of the electricity use. Recently, the water heating end use has begun to exhibit the same trend. Localized water heating is being provided at the dishwasher and special boosters at the point of demand. These appliances displace part of the central water heater's traditional loads but are typically assigned to the miscellaneous end use.

Over time, there will be a shift of electricity from the major end uses to the miscellaneous, even though no significant difference in service has occurred. The de-coupling trend has important implications for energy efficiency investments and programs. Efficiency investments in a specific appliance will be harder to justify when the savings accrue to an appliance that is only providing, say, 40% of the service. Thus, utility rebate programs to encourage purchase of efficient air conditioners will yield smaller savings because they cannot influence the energy consumed by fans and dehumidifiers. On the other hand, the de-coupling trend will probably save some energy. Most of the new appliances permit more precise applications of energy than the traditional appliance. For example, a hot water booster in a dishwasher allows the main water heater thermostat to be lowered which will more than make up for the added electricity use of the booster. Few measurements have been undertaken to demonstrate the savings achieved through greater precision of application.

The fragmentation of the relationship between end uses and specific appliances greatly complicates monitoring energy use in homes. Sensors for each of the contributing appliances will be needed to effectively monitor each end use. Moreover, each contributing appliance may provide a different aspect of the service. In air conditioning, for example, the fans provide air movement, de-humidifiers remove moisture, and air conditioners lower air temperature (and remove moisture). Thus, end use breakdowns based on monitoring will be subject to greater uncertainty.

New homes equipped with energy-efficient appliances will have a much larger proportion consumed by miscellaneous appliances. Due to higher levels of insulation, and more efficient refrigerators, air conditioners and water heaters, the energy used in the standard end uses has fallen as new miscellaneous uses have appeared. The 1990 California study of new, energy-efficient homes (see Table 1) found that 41% of their electricity use was consumed by miscellaneous appliances compared with national averages for existing homes of about 20%.

CONCLUSIONS

The miscellaneous category in residential electricity consumption is extraordinarily diverse. In the US, it is made up of hundreds of million of appliances consuming tiny amounts of energy and tens of millions of appliances consuming a lot of energy. While representing only about 20% of national residential electricity use, the fraction for a particular home can be much larger. Certain appliances, such as waterbeds, well pumps, and other equipment not typically considered to be domestic, can easily consume more than the conventional refrigerator, water heater, or lights.

The miscellaneous category will become relatively more important over time due to several trends. First, the standard appliances, such as refrigerators and water heaters, are using less energy due to energy efficiency standards and utility conservation programs. In some new homes, the miscellaneous category already accounts for over 40% of total electricity use. Second, certain standard end uses, which were previously serviced by a single appliance, are now being served by several appliances, some of which are treated as part of the miscellaneous category. Finally, the proliferation of non-domestic activities within the home, each requiring special equipment or appliances, is adding new electrical applications.

The high level of activity within the miscellaneous category suggests that it deserves careful monitoring by utility forecasters and planners. Failure to understand its present size and relationship to other end uses will lead to inaccurate forecasts and unsuccessful programs to save energy.

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